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A Sketch History of Meteorology in Poland
(between the 10th and 19th Centuries)

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A SKETCH-HISTORY OF METEOROLOGY IN POLAND (BETWEEN THE TENTH AND THE NINETEENTH CENTURIES)

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Editor's note.)

INTRODUCTION

Today, when we are beginning work on the development of meteorology in Labyrinth Island, it is worth while to look back and see what paths were taken before achieving the present stage of development. This look into the past is the more timely, because there has been a definite lack of interest in this direction.

One proof to support the above is the fact that currently published textbooks and treatises in the field of meteorology do not contain any mention of historical events or else give a sketch of the development of world meteorology which avoids - horribly - the contributions of Poles.

The fact that modern meteorology is tending rapidly toward a total transformation from a descriptive science to a mathematical science based on the laws of physics, the fact that we attempt to

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enter into all of the logical subtleties of our problems - does not permit us to look with disregard upon those who blazed the trail for the current blossoming of geo-physical sciences, regardless of how often these pioneers erred during their work. In the words of Jan Smiatecki in Geography or the Mathematical and Physical Description of the Earth (page 169):

"We do not deny that there may be arguments and difficulties against the thoughts outlined here, since the subject is so complicated and little known." And further: "Inspired by the pure desire to seek truth, we will be happy should a diligent inquiry into these thoughts be a reason either for seeking out a more perfect explanation of the known results and acts of nature or the discovery of such natural phenomena which up to now are hidden from us."

Having the above in mind, I have dared to put down a few words concerning the history of meteorology in Iceland, despite the fact that I had at my disposal only a few source materials.

THE EARLIEST PERIOD (BETWEEN THE TENTH AND THE FIFTEENTH CENTURIES)

Meteorology, just like any science, passed through three stages in its development. During the first stage, which we can name the observatio-

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nal, meteorologists make observations and diligently note the results. Next, there appear successful attempts at systematization of the collected material. Finally, meteorology entered upon the third stage of its development during which it was transformed from a descriptive science into a theoretical science. Due to this fact, general laws governing the atmosphere were discovered and on their basis the reciprocal causality of one set of phenomena and others.

The development of meteorology in Poland was not any different.

The beginning - as everywhere else - was the notation of phenomena that were threatening in their results to man. This type of notations, dating back to the oldest times, is exemplified in the treatise by Maria Polackowna. She based her work on data in Events by Blugosz as well as on the six volumes of Historical Monuments of Poland by Bielawski. She gives a full extract from sources in which there were climatological notations as well as tables for cold winters, rainy summers and the opposite when the winters were mild and the summers hot. The first of these notations concerns the extremely cold winter in the year 940 A.D., the entry of which was taken from the Krakow Yearbook of Short Supplement ("Annalium Cracoviensium brevium Complementum").

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Beginning with the year 940 and going almost to the end of the fifteenth century, that is to the death of Bluzosz (1480), Tolaczkowa has noted all of the years with an exceptional maximum or minimum temperature.

Apart from the more or less detailed notations concerning unusual phenomena, the science of optics was worked out in the thirteenth century by the first Polish scientist on a European scale named Ciolek (born about 1270) who was called by the Latin name of Witellon. Ciolek has the reputation of having been one of the greatest learned men of his times and simultaneously the first person in Europe to promulgate the principles of geometrical optics. A treatise on optics by Ciolek, worked out much earlier, appeared in print in 1535 as a thick volume containing 804 pages. The book gained great fame, so that 10 years after the first edition a second was issued and later a third.

Ciolek wrote his work about 1277 and entitled it Opticæ Libri Decem (Optics in Ten Books), having divided the whole into ten sections. The last one of these deals among other matters with atmospheric phenomena and belongs without any doubt to the most important and most interesting chapters because it contains most of the thoughts of the au-

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ther. Regarding the atmosphere, Cicolek stated that the earth was surrounded by air which became more rarified the farther it was away from the earth. Taking the foregoing into consideration as well as the angle of the sun going down under the horizon at the time that twilight ends, he computed - in the steps of Arab scientists - the height of the atmosphere at which air is still able to reflect sun rays toward the earth. He judged the height of the atmosphere on this basis to be 52,000 steps. He discusses the rainbow phenomenon in statement 85 of book 10, saying that a rainbow is created by the breaking and reflecting of light in a "rose vapor" (vapor rosarius). Under the latter term, he understood an intermediate form between water vapor condensed in a cloud and drops of rain falling toward the earth. Cicolek states that a rainbow cannot be formed in rain drops falling toward earth, because the rainbow's stability contradicts this, as well as its stationary position. (These were even so daring thoughts, because it was almost 400 years later that Newton gave a full explanation to the phenomenon of the rainbow. Cicolek's ideas were developed only at the beginning of the seventeenth century by the Yugoslav archbishop Marek Antoni de Dominis, based on experiments with a glass ball filled with water. The views of Dominis were modified and supported by theoretical data by Cartesius, but

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it was Newton (1704) who finally gave a full explanation of the rainbow phenomenon on the basis of the theory of colors which he had worked out.) Cicalek also discusses in his optics the halo phenomenon, attributing different reasons to its various forms. According to Cicalek, light arcs are formed as a result of the bending of sun rays or moon rays in water vapors (a vapore humido), and secondary suns or moons arise thanks to a reflection of light rays from fog. —

Varler supplemented and corrected Cicalek's ideas by publishing a book entitled ad Vitelliensem Emendationem. In connection with the ideas propagated by Cicalek, there appeared in London in 1711 a 110 page book entitled Elementa Opticae (The Elements of Optics) which was completely devoted to his studies and which announced the greatness of the creator of these ideas. (The title page in the book shows a picture of Vitellon looking into a mirror of water and carries the inscription "Vitellio Polonus, Optica scripserit" (the Pole Vitellon wrote on Optics) as well as a laudatory rhyme with the following content: "When a Pole looks into the fascinating arc of the sky, and often meets upon his own picture in the water, he admires these phenomena, penetrates them in thought, and guesses the reasons in an experimental spirit. That is the way in which his excellent work arose.")

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Even in those times, the explanation of optical phenomena was based on laws of physics. As far as weather forecasting was concerned, astro-meteorology ruled supreme. Even such a learned man as Kepler (born about 1571, died 1630) made queer statements on this topic, statements which did not correspond to his intellectual level. He said, for example, that the planet Mercury has the power to bring bad weather, that the sky must be cloudy when planets are close to each other, and that when they are at a 90 degree angle from each other - rain falls. Weather was foretold in these days for a longer period on the basis on the influence of the stars. The results were incorporated into astrological calendars, and the authors of these forecasts used to make the queerest astro-meteorological speculations. In Poland, especially in the fifteenth and at the beginning of the sixteenth centuries, many such astrological calendars were made up and they had great fame even outside of the borders of that country. They became especially widely known after a chair of astrology had been established at the Krakow Academy. The professor of these studies had the duties of drawing up such a calendar that contained meteorological forecasts, estimates of crops, ~~the~~ ruling fate, etc. Among those who made up such prognostications were the following: Professor Jan from Wielki Glo-

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gow in Gilezia for the year 1479 and several subsequent years, Jan Wirdung the court astrologist and author of a treatise on optics, Professor Leonard from Dobrzyce, Michal from Wislica, and others.

ENVIRONMENTAL WORK FROM SIXTEENTH TO EIGHTEENTH CENTURIES

Some calendars, apart from worthless forecasts in astrology, also contain valuable observations of the weather made without instruments and noted on the margins. They are of immeasurably greater value than some of the doubtful ones that have been made by instruments and appear to be accurate. These notations, concerning phenomena easily visible by the eye and systematically conducted by careful and honest observers in past centuries (they were begun in 1471), are of unestimated value and consist of about 10,000 entries on the state of weather in Krakow (the Krakow notations were preceded only by the English series of non-instrumental observations on the state of the weather, conducted during the years 1337-1344 by William Merle at Driby). These Polish notations, even though made without instruments, characterize the everyday state of the weather that one is tempted - according to Professor Birkenmajer - to recreate the climatic conditions of Krakow at the first half of the sixteenth century. Of especial value are the notations kept for intervals during the years 1490-1540 by Professor Marcin Biem (died 1540) who had

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been rector and deputy chancellor of the Krakow University many times. The almanac in which Biem kept his notes has all of the free spaces so thickly covered with additions that the printing is often covered by the handwriting. Similar notations, although to a more limited extent, were being kept by: Leonard from Dobrzyce, Michal from Wislica and Wojciech from Brudzew (died 1495), the latter of whom was Nikolaj Kopernik's professor as well as a professor and later a colleague of Marcin Biem. Unfortunately, despite the fact that these works were discovered by Professor Birkenmajer, they have not as yet been published and we lack a document establishing the high degree of scientific studies in those days. (In the next, that is the ~~15th~~^{16th} century, the governor of Litchsk province, Jan Antoni Chranowiecki, kept up similarly valuable notations. Beginning with the year 1665, he daily noted for eight years the detailed state of the weather.) There were also begun in Krakow (from the year 1690) experiments concerning the changes taking place in the plant and animal world in relation to the annual course of climatological conditions. This was the beginning of phenology.

We must also note during this time the unusual fact of the first in Poland (and we are under the impression that also first in the world) theo-

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retical ideas in the field of aerology. Mikolaj Kopernik in his book On the Revolutions of Heavenly Bodies (from the year 1543) quotes a statement by Ptolemy to the effect that if the earth really revolved then "the clouds as well as all other bodies suspended in the air would be seen by us as always travelling toward the west." Since observations of the disposition of the sky did not substantiate the above point of view, Ptolemy came to the conclusion that the atmosphere did not participate in the revolving movement of the earth. In answer to this erroneous view, Kopernik stated (chapter 8, book 1) that, "not only the earth but also water, the latter being connected with the former, revolve together and are accompanied by a large part of the air (author's italics) and everything that has any connection with the earth." Kopernik states, therefore, that "a large part of the air" revolves and participates in the movement of the earth. Further, the air seems to be stationary unless it is "moved by wind or some other propulsive force, as occurs, in this or some other direction." Kopernik does not rest on the above statement but attempts to explain the phenomenon by saying that the movement is transferred by traction of the air against the surface of the earth. He writes that "this takes place either because the closest part of the air is mixed with earthly or

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watery parts and undergoes the same law of nature as the earth or perhaps because the movement of the air is acquired from the earth because of contact with it during its incessant rotation." Taking into consideration that "a large part of the air" participates in the revolving movement of the earth, Kopernik states that "we can consider the upper zone of air, which is quite far from the earth, as lacking this earthly movement." Kopernik's view on the stationary position of the highest layers of the earth's atmosphere, although based on flimsy foundations, was a forerunner by 400 years of the scientific confirmation that there exist in the upper regions of the atmosphere eastern winds which result from "immovability" of the atmosphere at that place. (Kopernik's thesis found experimental corroboration only in 1883 when, after the explosion of Krakatau's eruption, volcanic dust rose to the height of 30 kilometers and went around the world from east to west together with an eastern wind.)

If Kopernik's ideas which were typically premature did not claim any attention, the treatises published by the Caruchin monk Walerian Magni, attached to the court of Wladyslaw IV, did attract European fame. The phenomenon of the barometric vacuum, described by Magni, became a passion with the current scientific world. Magni who stayed at

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the court of Wladyslaw IV from 1638 to his death in 1648 was a strong adherent of the thoughts expressed by Galileo and, under the influence of the latter's Discussions, he decided to conduct experiments with a vacuum. The impossibility of obtaining the appropriate glass tubes postponed the experiment to 1647. During that year, he demonstrated the phenomenon of a vacuum before the king and his court and also published the results of his experiments. Immediately after Magini's work was published, representatives of both academies announced themselves against him. Treatises appeared by Professor Jan Brozka of the Krakow Academy, Professor Wojciech Rojalewicz from the Wilno Academy, and others, all of whom attempted to prove that the existence of a vacuum is impossible and contrary to the theories of Aristotle. Even Pascal and the scientists around him were against Magini, accusing him of having committed plagiarism by announcing somebody else's discoveries as his own. In answer to this accusation, Magini used the following words to Rebervai: "Your wisdom will forgive Walerian if he did not know that what he attained by his own thoughts and perfected had already been done by somebody prior to him. I am at any rate the first to have announced this in print, making it known to the largest and best part of Europe."

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I did this not motivated by the desire to take the laurels of first discovery but in order to prepare the minds of scientists to a less unwilling attitude toward my philosophy that is closer to light." As far as can be ascertained from accessible sources, Nagni probably conducted his experiments unaware of the work of his predecessors. It should be noted that Nagni's contribution would not have been possible without the friendly relationship of King Wladyslaw IV who permitted the propagation in Poland of Galileo's theories so strictly prohibited in Italy.

(to be continued)

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